Part 2 – The Solution
Sustainability Frameworks

US Army Installation Sustainability Training

Aug 04

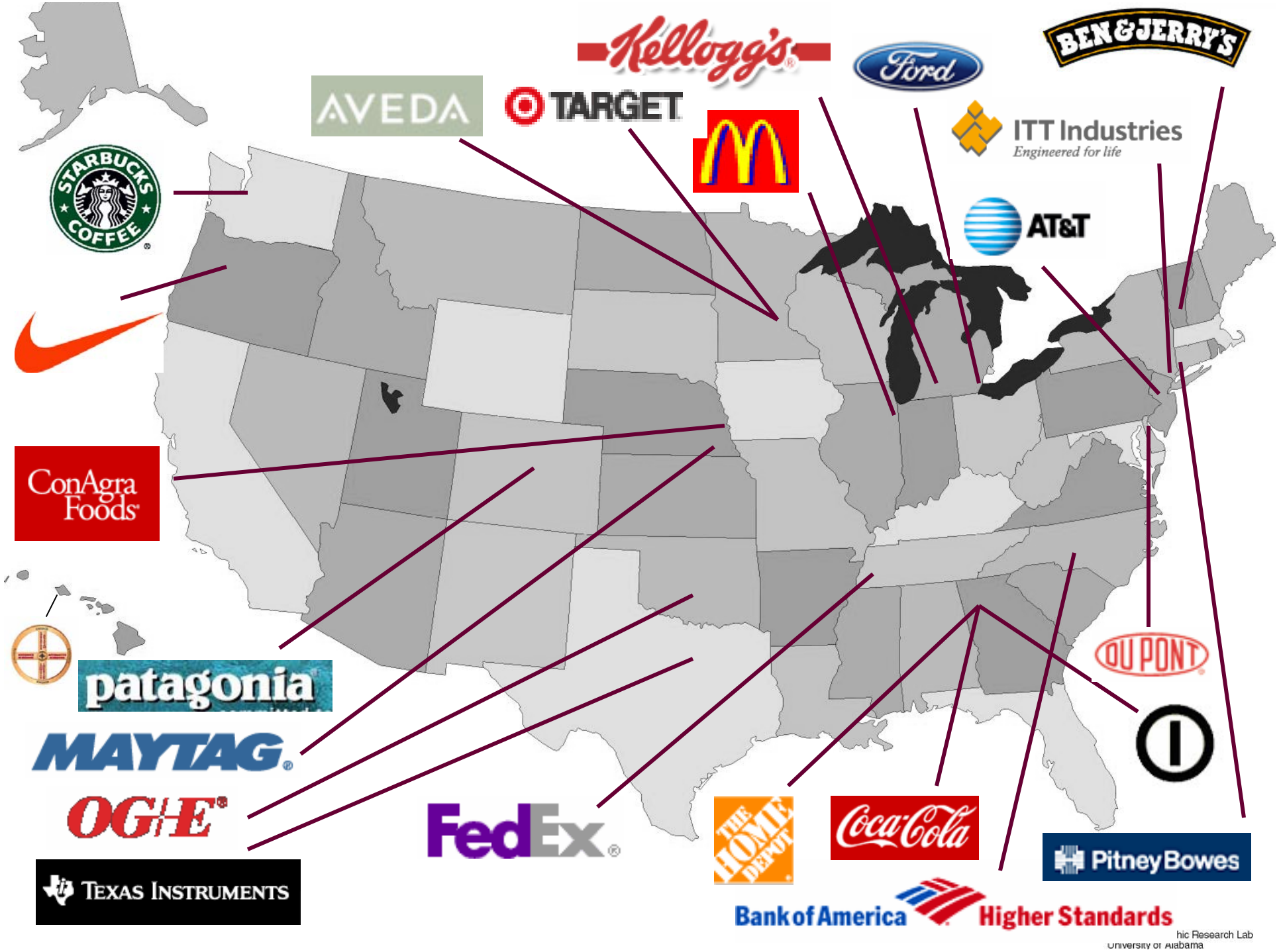
Objectives

1. *There's a challenge – military installations are increasingly impacted by resource, community and land use issues*
2. *There's a solution – "sustainability" is a framework used by the business community to balance economy, well-being, and environment*
3. *There's a process – for integrating sustainability into installation planning*
4. *There are results*

Business definition of sustainability

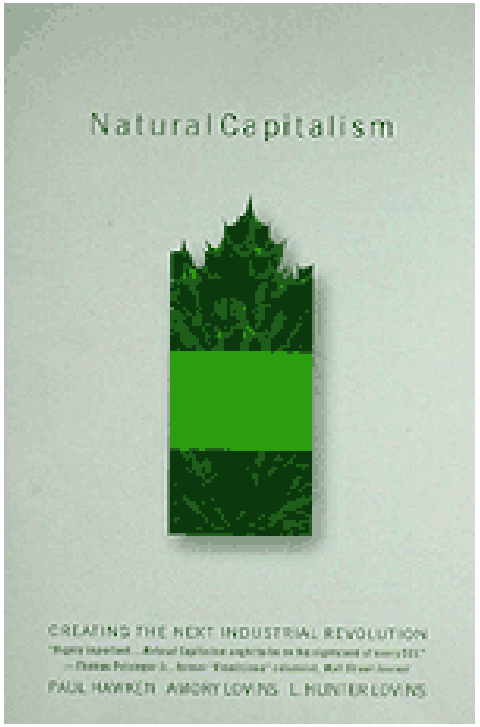
SERO

- **Businesses face the same constraints installations do**
- **Business leaders are aware that survival is not just about short-term profit, but long-term management of three capital accounts:**
  - ✓ **Financial**
  - ✓ **Human**
  - ✓ **Natural**
- **The "triple bottom line"**
  - ✓ **Profit**
  - ✓ **People**
  - ✓ **Planet**

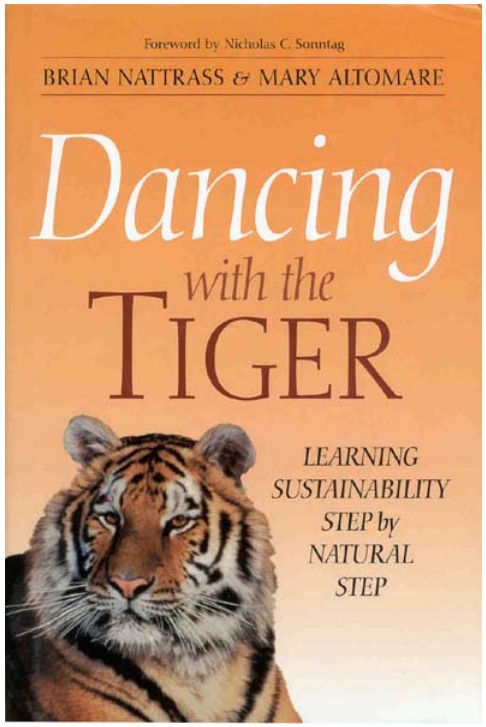


hic Research Lab
University of Alabama

Sustainability Frameworks



Natural Capitalism
"Four Tools"



The Natural Step
"Four Rules"

Natural Capitalism

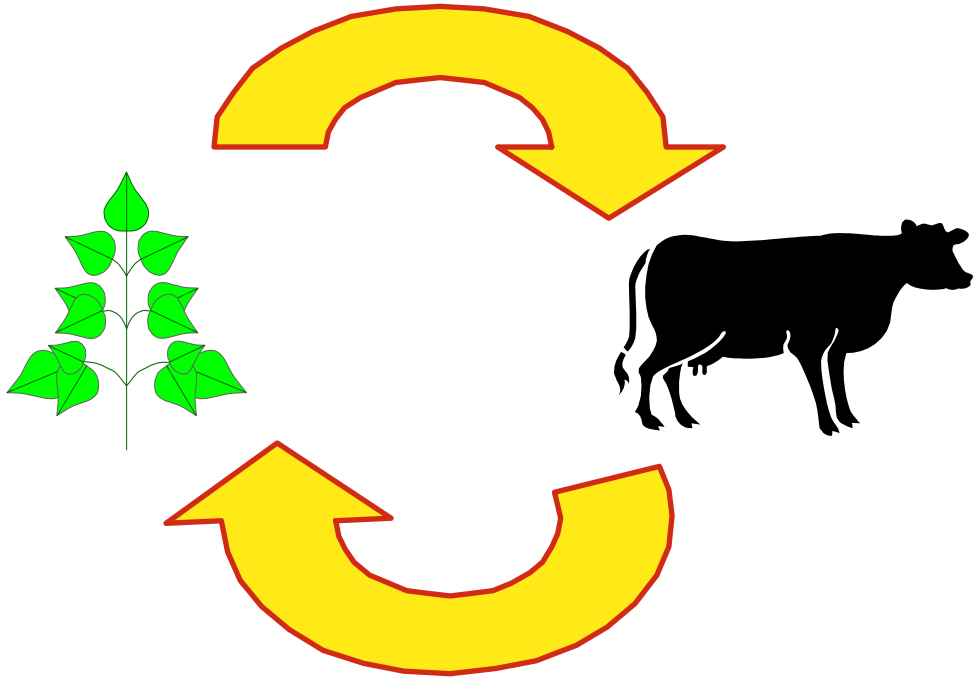
- Rocky Mountain Institute
- "Natural Capitalism – Creating the Next Industrial Revolution," Lovins, Lovins, and Hawken, 1999
- Four Tools
  - ✓ Radical Resource Productivity
  - ✓ Biomimicry
  - ✓ Service and Flow Economy
  - ✓ Investing in Natural Capital

Radical Resource Productivity

- **Factor 4, Factor 10, Factor 100**
  - ✓ **providing products/services with ¼, 1/10, or 1/100 current energy and materials use**
  - ✓ **Austria, Netherlands, Norway, Dow Europe, Mitsubishi**
- **Does anyone know the cost/kwh of the energy in a solar-powered calculator?**

Biomimicry

In cyclical natural systems, waste does not exist.



Waste = Food

Biomimicry

SERO

Also, look to the 3 Billion Year R&D process nature has given us…

- Spider Web (thread strength) for Kevlar
- Slug mucous (lubricant) for oil
- Abalone Shell (protective material) for composites
- Barnacle (adhesives) for epoxies
- Lotus flower (waterproofing) for synthetics
- Geckos (small hairs as glue) for various adhesives
- Pond Scum – 95% efficient in photosynthesis

Service and Flow Economy

- Consumers lease goods
- Manufacturers provide services
  - ✓ Own equipment “cradle to cradle”
- Provides incentives for design for re-manufacture and durability
- Many examples
  - ✓ cars – BMW
  - ✓ carpet – Interface, Inc
  - ✓ coolth – The Carrier Corporation
  - ✓ copiers – Xerox
  - ✓ RCI

They're in it for the money…

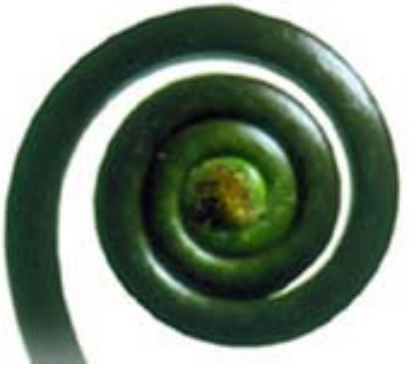
- Ray Anderson's vision for Interface: "If we get it right … we will never have to take another drop of oil from the earth for products or processes."
- He believes that in the 21st Century, the resource-efficient will win at the expense of the resource-inefficient
- … new fortunes are to be made in the Next Industrial Revolution
- … and when his competitors have to pay the true price of oil, he'll kick their butts

Ray Anderson
Chairman
Interface Inc

Investing in Natural Capital

- **$36 trillion is the estimated worldwide value of ecosystem services such as flood control, water cleansing, air purifying, nutrient recycling etc (1997 dollars)**
- **$39 trillion was the Gross World Product in 1997 – the sum of all economic activity**
- **Already beyond the theoretical**
  - ✓ **New York City water system**
  - ✓ **"The New Economy of Nature"**

    Dailey and Ellison, 2000



the NATURAL STEP

SERO

- **International organization and consensus**
- **Books**
  - ✓ **"The Natural Step for Business," Nattrass and Altomare, 1998**
  - ✓ **"Dancing with the Tiger," Nattrass and Altomare, 2002**
  - ✓ **"The Natural Step for Communities"**
- **Derived from fundamental scientific principles**
- **Simplifies complex economic-well-being-environmental issues**
- **Provides a "systems" perspective of the whole earth**

the NATURAL STEP

SERO

- **Four Rules – "system conditions"**
- **In a sustainable society, nature is not subject to increasing…**
  1. ***… concentrations of substances extracted from the Earth's crust;***
  2. ***… concentrations of substances produced by society;***
  3. ***… degradation by physical means.***
  4. ***And basic needs are met worldwide.***

System Condition 1

In a sustainable society, nature is not subject to systematically increasing:

… concentrations of substances extracted from the Earth's crust.

What does this mean?
Who's got an example?

System Condition 1

In a sustainable society, nature is not subject to systematically increasing concentrations of substances extracted from the Earth's crust.

This means substituting certain minerals that are scarce in nature with others that are more abundant, using all mined materials efficiently by reusing them in closed loops, and systematically reducing dependence on non-renewable materials and fuels.

Telling Indicators

SERO

- In 2000, mines extracted 900M tons of metal and produced 6B tons of waste ore worldwide
- Projected US clean-up costs for mines is $24B
- Worldwide, mining provides 1% of jobs and is responsible for 5% of the work-related deaths (14,000/year)

The Other Choices?

SERO

- **Wind Energy**
  - ✓ Cost 3-5 cents/kWh
  - ✓ 6,000 MW by 12/03 ($6Billion investment)
  - ✓ 2^{+} cents/kWh by 2020
  - ✓ Down from 40 cents in 1980
- **Solar photovoltaics**
  - ✓ $2 billion global industry
  - ✓ Cost 16-25 cents/kWh
  - ✓ DOE 2020 goal: 6 cents
  - ✓ Down from $1 in 1980
- **Biomass Power**
  - ✓ 350 power plants in U.S.
  - ✓ 7,000 MW of power

System Condition 2

the NATURAL STEP

- HALOGENATED COMPOUNDS
chlorodifluoromethane
chlorotrifluromethane
dichlorofluoromethane
chloromethane
trichlorofluoromethane
dichloroethylene
Freon 113
methylene chloride
chloroform
1,1,1 - trichloroethane
carbon tetrachloride
trichloroethylene
chloropentane
dibromochloromethane
tetrachloroethylene
dichloropropene
chlorobenzene
iodopentane
3-methyl-1-iodobutane
chloroethylbenzene
dibromodichloromethane
dichlorobenzene
chlorodecane
trichlorobenzene

- ALDEHYDES
acetaldehyde
methyl propanal
n-butanal
methylbutanal
crotoaldehyde
n-pentanal
n-hexanal
furaldehyde
n-heptanal
benzaldehyde
n-octanal
phenyl acetaldehyde
n-nonanal
methyl furaldehyde
n-decanal
n-undecanal
n-dodecanal

- KETONES
acetone
methyl ethyl ketone
methyl propyl ketone
methyl vinyl ketone
ethyl vinyl ketone
2-pentanone
methyl pentanone
methyl hydrofuranone
2-methyl-3-hexanone
4-heptanone
3-heptanone
2-heptanone
methyl heptanone
furyl methyl ketone
octanone
acetaphenone
2-nonanone
2-decananone
alkylated lactone
phthalide

- OXYGENATED ISOMERS
C4H6O
C4H8O
C5H10 O
C6H8O
C6H10 O
C4H6O2
C6H12 O
C7H10 O
C7H14 O2
C6H6O2
C6H14 O2
C6H16 O
C7H8O2
C7H10 O2
C9H18 O
C8H6O2
C10H12 O2
C10H14 O
C10H16 O
C10H18 O
C10H20 O
C10H22O
C9H8O2
C11H20O

- ALCOHOLS
methanol
isoproponal
2-methyl-2-propanol
n-proponal
1-butanol
1-pentanol
x-furfuryl alcohol
2-ethyl-1-hexanol phenol
2,2,4-trimethylpenta-1,3-diol
x-terpineol

- ACIDS
acetic acid
decanoic acid

- SULFUR COMPOUNDS
sulfur dioxide
carbon disulfide
dimethyl disulfide
carbonyl sulfide

- NITROGEN COMPOUNDS
nitromethane
methyl acetamide
benzonitrile
methyl cinnoline

- ESTERS
vinyl propionate
ethyl acetate
ethyl-n-caproate
isoamyl formate

- ETHERS
dimethyl ether
dihydropyran

- EPOXIDE
1,8-cineole

- FURANS
furan
tetrahydrofuran
methyl furan
methyl tetrahydrofuran
ethylfuran
dimethylfuran
2-vinylfuran
furaldehyde
2-n-butylfuran
2-pentylfuran
methylfuraldehyde
furyl methyl ketone
benzofuran

- ALKANES
13 in the group

- ALKENES
11 in the group
isoprene

- ALKYNES
7 in the group

- CYCLIC
cyclopentane
methyl cyclopentane
cyclohexane
C10H14 isomers
C10H16 isomers
limonene
methyl decalin
x-pinene
campene
camphor
e. methyl cyclohexane

- AROMATICS
benzene toluene
ethylbenzene
xylene
phenyl acetylene
styrene
benzaldehyde
methyl styrene
dimethyl styrene
C5-alkylbenzene isomers
napthalene
C6-alkylbenzene isomers
C3-alkylbenzene isomers
C4-alkylbenzene isomers

In a sustainable society, nature is not subject to systematically increasing:

…concentrations of substances produced by society.

What does this mean?

Who's got an example?

System Condition 2

the NATURAL STEP

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trichloroethylene
chloropentane
dibromochloromethane
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benzaldehyde
n-octanal
phenyl acetaldehyde
n-nonanal
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methyl heptanone
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octanone
acetaphenone
2-nonanone
2-decananone
alkylated lactone
phthalide

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C5H10 O
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C6H12 O
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C6H14 O2
C6H16 O
C7H8O2
C7H10 O2
C9H18 O
C8H6O2
C10H12 O2
C10H14 O
C10H16 O
C10H18 O
C10H20 O
C10H22O
C9H8O2
C11H20O

- ALCOHOLS
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isoproponal
2-methyl-2-propanol
n-proponal
1-butanol
1-pentanol
x-furfuryl alcohol
2-ethyl-1-hexanol phenol
2,2,4-trimethylpenta-1,3-diol
x-terpineol

- ACIDS
acetic acid
decanoic acid

- SULFUR COMPOUNDS
sulfur dioxide
carbon disulfide
dimethyl disulfide
carbonyl sulfide

- NITROGEN COMPOUNDS
nitromethane
methyl acetamide
benzonitrile
methyl cinnoline

- ESTERS
vinyl propionate
ethyl acetate
ethyl-n-caproate
isoamyl formate

- ETHERS
dimethyl ether
dihydropyran

- EPOXIDE
1,8-cineole

- FURANS
furan
tetrahydrofuran
methyl furan
methyl tetrahydrofuran
ethylfuran
dimethylfuran
2-vinylfuran
furaldehyde
2-n-butylfuran
2-pentylfuran
methylfuraldehyde
furyl methyl ketone
benzofuran

- ALKANES
13 in the group

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- CYCLIC
cyclopentane
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C10H14 isomers
C10H16 isomers
limonene
methyl decalin
x-pinene
campene
camphor
e. methyl cyclohexane

- AROMATICS
benzene toluene
ethylbenzene
xylene
phenyl acetylene
styrene
benzaldehyde
methyl styrene
dimethyl styrene
C5-alkylbenzene isomers
napthalene
C6-alkylbenzene isomers
C3-alkylbenzene isomers
C4-alkylbenzene isomers

In a sustainable society, nature is not subject to systematically Increasing concentrations of substances produced by society.

This means systematically reducing dependence on synthetic compounds known, or suspected to be, harmful to living systems.

Telling Indicators

- **The cost for clean-up of synthetic organic chemicals through the "Superfund" – about $87B from 1981 through 2010. Source: EPA**
  - ✓ **This does not include mining or nuclear waste or any future materials to be regulated.**
- **DOD has spent $27B, and estimates an additional $33B required**
  - ✓ **This does not include range residues**

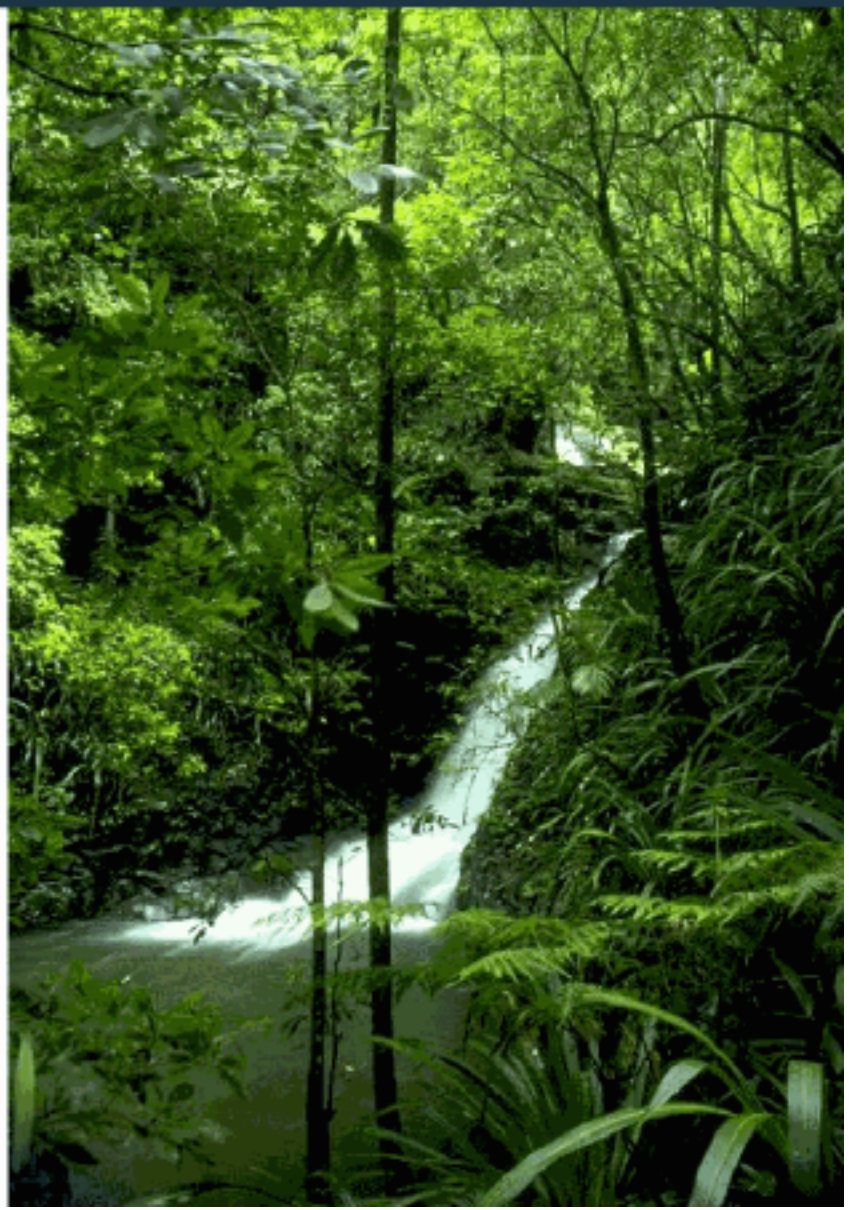
System Condition 3

In a sustainable society, nature is not subject to increasing:

… degradation by physical means.

What does this mean?

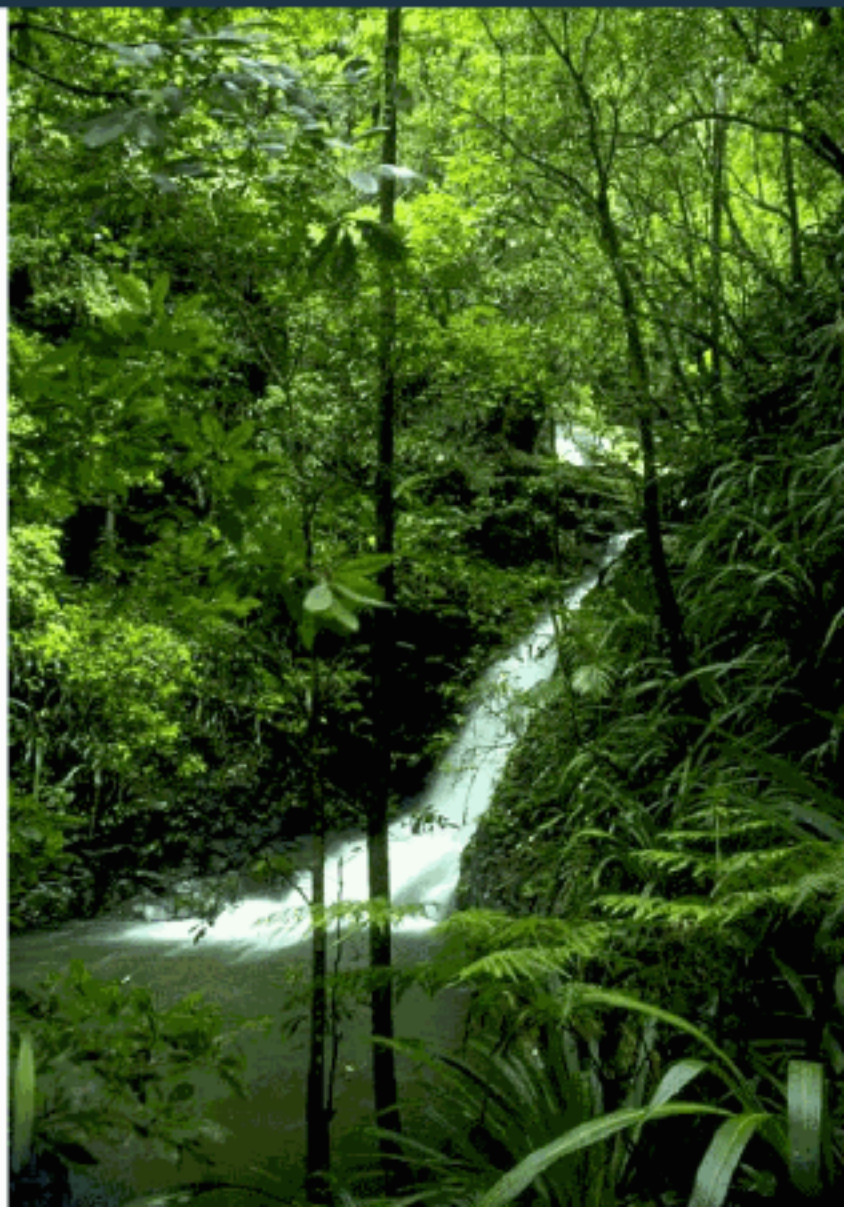
Who's got an example?



System Condition 3

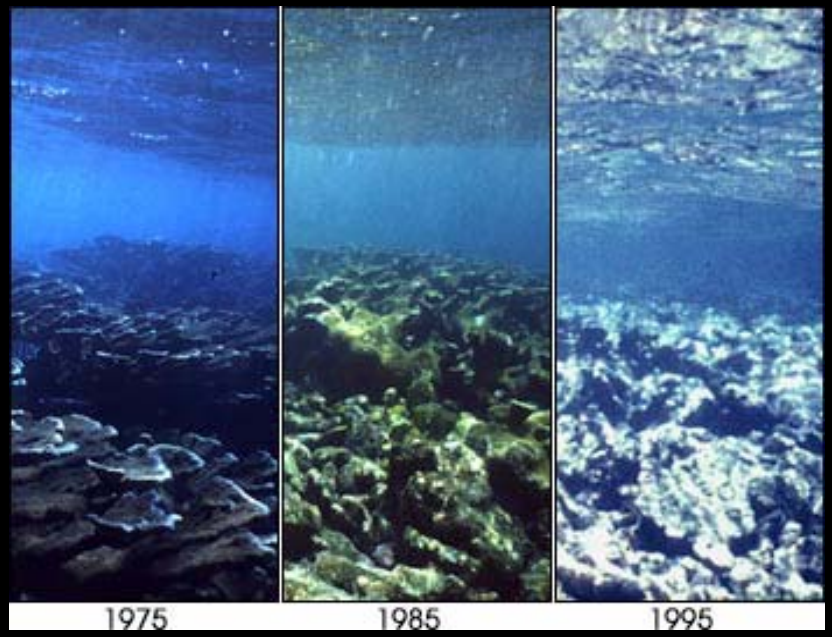
In a sustainable society, nature is not subject to increasing degradation by physical means.

This means that the productive mechanisms of nature are not diminished in quality or quantity, and we must not harvest nature beyond its capacity to regenerate.



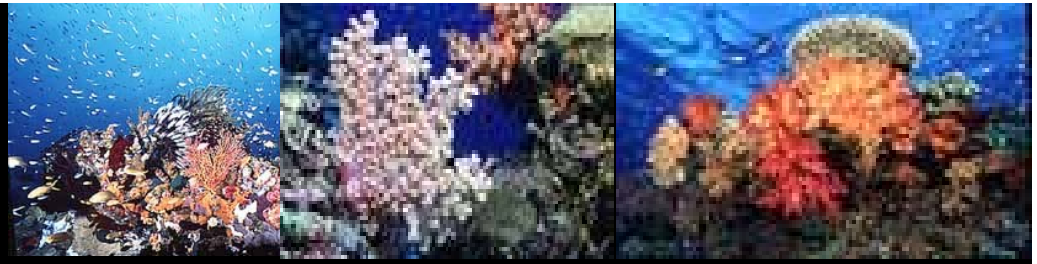
Researchers estimate that nearly 60 percent of the world's reefs are now seriously threatened.

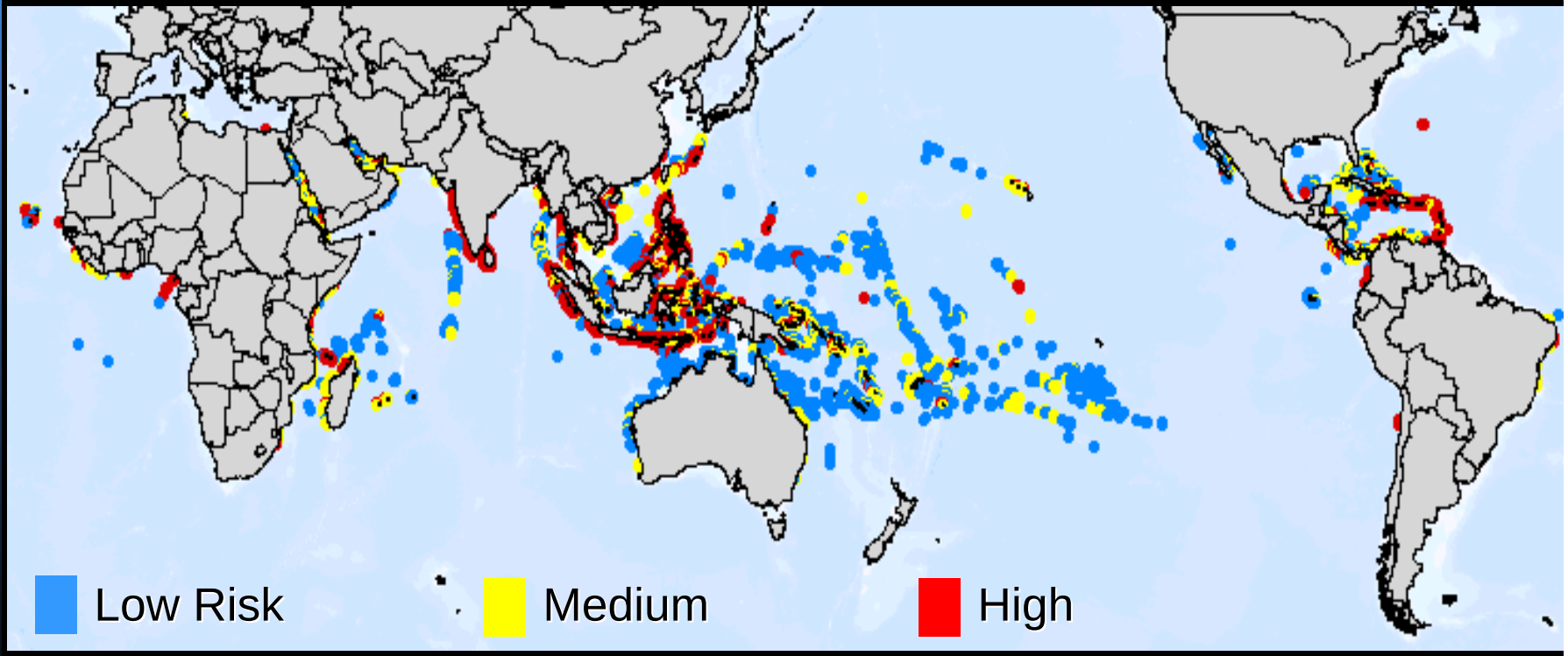
Source:
http://www.nasa.gov/vision/earth/environment/coral.html



SUSTAINABILITY PARTNERS

Reefs at Risk





Three billion people depend on reefs for their major source of protein.

SUSTAINABILITY PARTNERS

Source: ***World Resources 2000-2001***

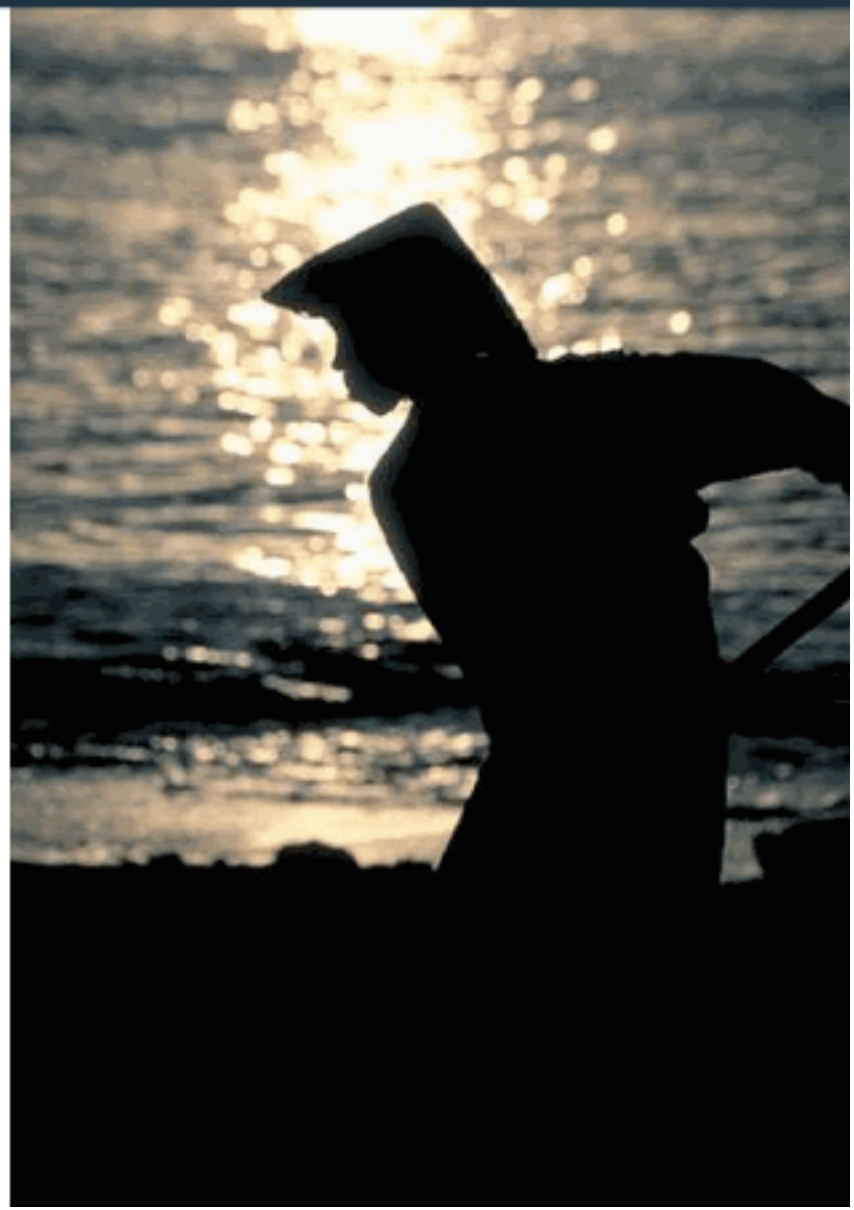
System Condition 4

the NATURAL STEP

In a sustainable society:

Basic needs are met worldwide.

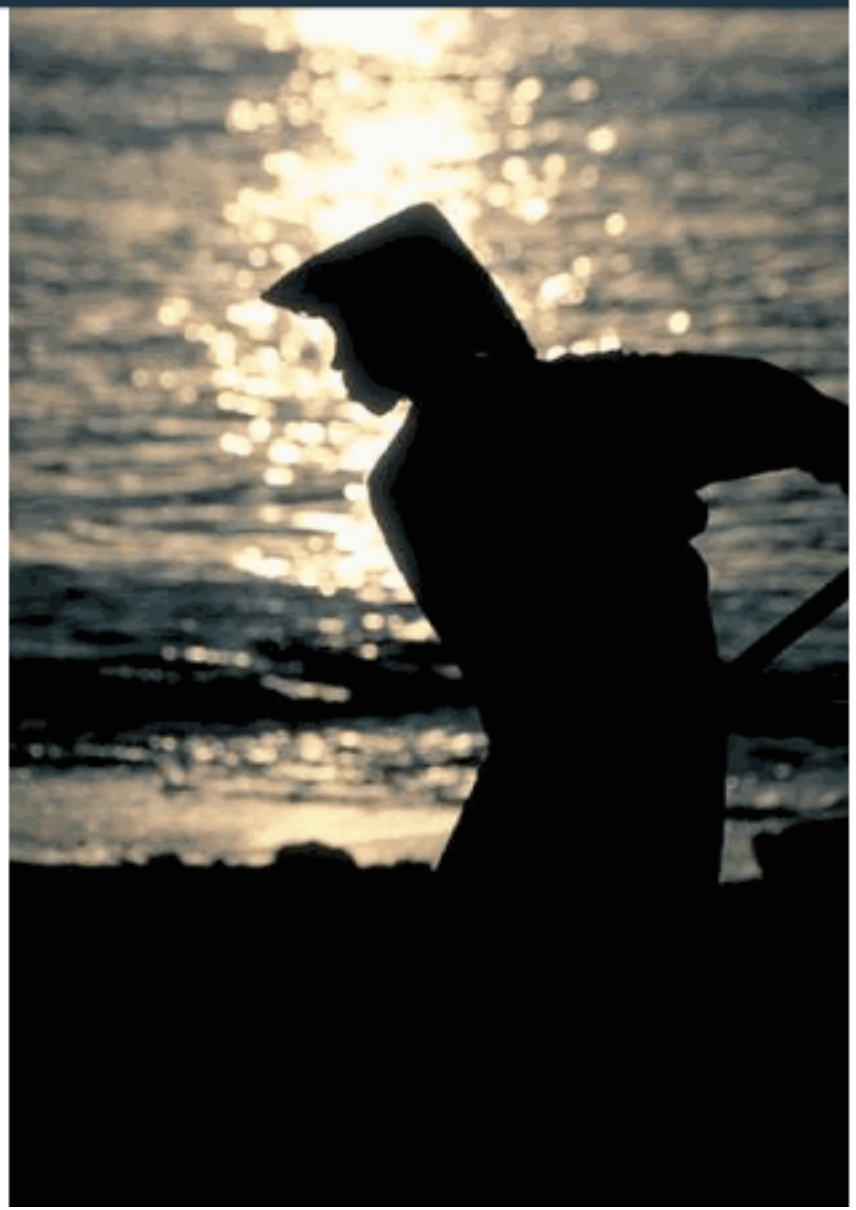
What does this mean?
Who's got an example?



System Condition 4

In a sustainable society, basic needs are met worldwide.

This means using resources efficiently, fairly and responsibly, so that the needs of all people, now and in the future, stand the best chance of being met.



Telling Indicators

SERO

Afghanistan facts:

- **23.8 million people -> 44m by 2025**
- **Life expectancy - 43.1 years**
- **14.7 % infant mortality rate**
- **13% access to safe drinking water**
- **12% access to sanitation - 21% in 1970**
- **3% or less forest lands**
- **12% arable lands including forests**
- **Food production dropped by 40% 1995 to 2000**

Source: Military Science of Environmental Security, Brief by COL Chris King, PhD, USMA

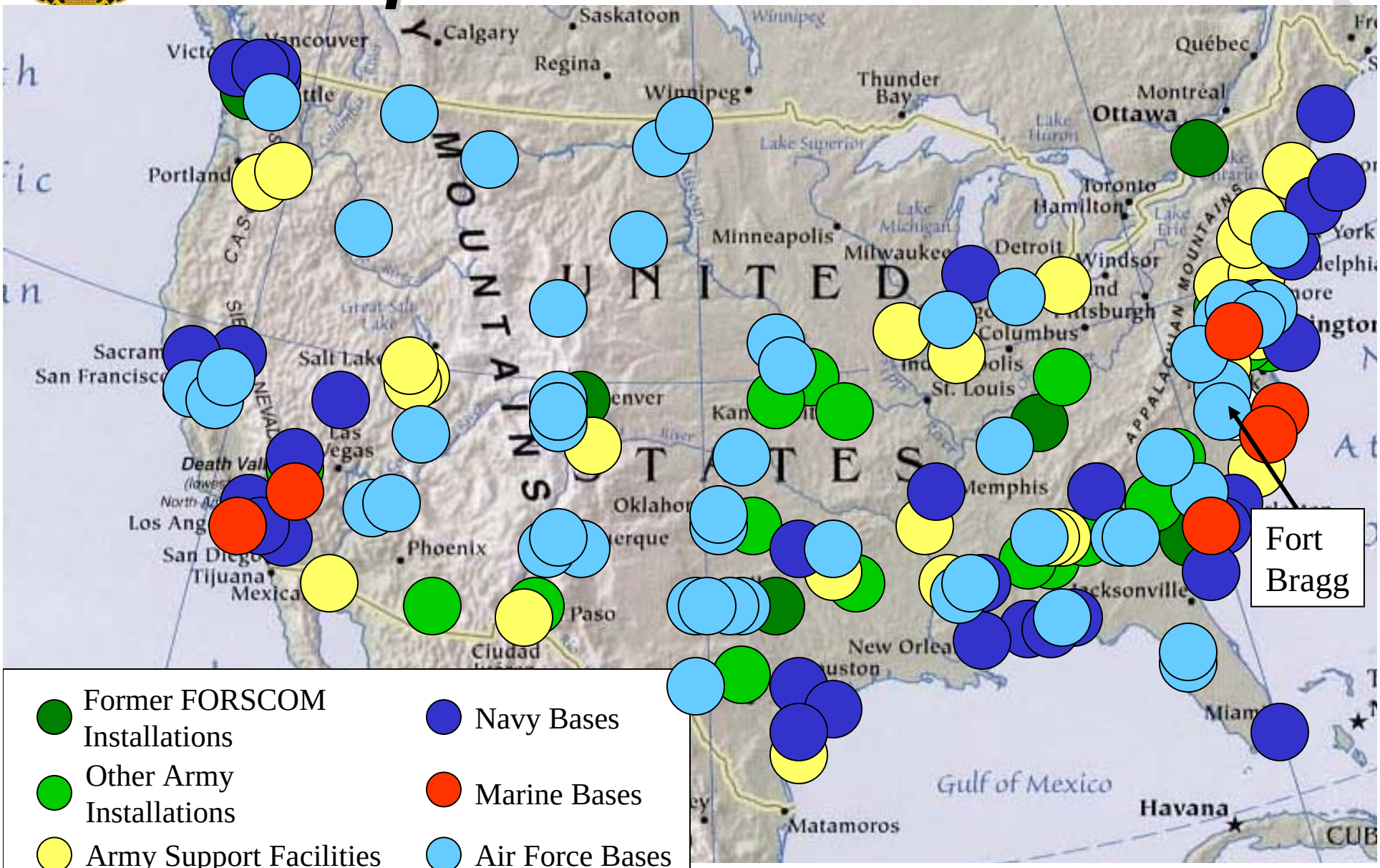
The security-sustainability dynamic

Security – freedom from fear of privation or attack.

Webster's New World Dictionary

Sphere of Influence

SERO



What to do?

The difference between what we do and what we are capable of doing would suffice to solve most of the world's problems…

Mohandas Gandhi

BACKUPS

The following slides were graciously provided by Mary and Brian Nattrass, authors of…

Dancing with the Tiger

Learning sustainability Step by Natural Step

The Goal of Sustainability

The Rules of This System

Closed with respect to matter

Open with respect to energy

Basic Science – All Scientists Agree

- Matter and energy do not disappear
- Matter and energy become less ordered, concentrated, and structured
- The quality (usefulness) of matter and energy decreases as it becomes less ordered
- Photosynthesis is the major process by which order is produced

Science - Demonstration

WHO NEEDS SOME CHOCOLATE?